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ABSOLUTE IXARC ROTARY ENCODER WITH CANOPEN INTERFACE
USER MANUAL

CANopen

Main Features

- Compact and heavy-duty industrial design
- Interface: CANopen / CAN
- Housing: 58 mm ∅
- Solid/hollow shaft: 6 or 10mm∅ / 15mm∅
- Max. 65536 steps per revolution (16 Bit)
- Max. 16384 revolutions (14 Bit)
- Code: Binary
- Velocity and Acceleration Output

Programmable Parameters

- Direction of rotation (complement)
- Resolution per revolution
- Total resolution
- Preset value
- Two limit switches and eight cams
- Baud rate and CAN-identifier
- Transmission mode: Polled mode, cyclic mode, sync mode
- Layer Setting Services

Mechanical Structure

- Aluminium flange and housing
- Stainless steel shaft
- Precision ball bearings with sealing or cover rings
- Code disc made of unbreakable and durable plastic

Electrical Features

- Temperature insensitive IR-opto-receiver asic with integrated signal conditioning
- Connection cap: Status indication with two LEDs
- Polarity inversion protection
- Over-voltage-peak protection

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CANOPEN

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General Security Advise

Important Information
Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Please Note
Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by POSITAL for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About this Manual

Background

This user manual describes how to install and configure an OCD absolute rotary encoder with CANopen interface.

Relate Note

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User Annotation

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ABSOLUTE IXARC ROTARY ENCODER
CANOPEN

1. Introduction

This manual explains how to install and configure the OPTOCODE II absolute rotary encoder with CANopen interface applicable for military and industrial applications with CANopen interface. The product is fully compliant with CiA-standards:

DS301V402 CANopen Application Layer
DR303-1 Cabeling and connector pin assignment
DR303-3 CANopen indicator specification
DS305V200 CANopen Layer Setting Service
DS306V1R3 Electronic datasheet specification
DS406V32 Device Profile for Encoders

Measuring System

The measuring system consists of a light source, a code disc pivoted in a precision ball bearing and an opto-electronic scanning device. A LED is used as a light source which shines through the code disc and onto the screen behind. The tracks on the code disk are evaluated by an opto-array behind the reticle. With every position another combination of slashes in the reticle is covered by the dark spots on the code disk and the light beam on the photo transistor is interrupted. That way the code on the disc is transformed into electronic signals. Fluctuations in the intensity of the light source are measured by an additional photo transistor and another electronic circuit compensates for these. After amplification and conversion the electronic signals are available for evaluation.

Single-Turn

Single turn encoders specify the absolute position for one turn of the shaft i.e. for 360°. After one turn the measuring range is completed and starts again from the beginning.

Multi-Turn

Linear systems normally need more than one turn of a shaft. A single turn encoder is unsuitable for this type of application because of the additional requirement of the number of turns. The principle is relatively simple: Several single turn encoders are connected using a reduction gear. The first stage supplies the resolution per turn, the stages behind supply the number of turns.

There are several types of encoder versions. Please refer to the datasheets to find out which is the best version for your application.

1.1 General CANopen Information

The CANopen system is used in industrial applications. It is a multiple access system (maximum: 127 participants), which means that all devices can access the bus. In simple terms, each user checks whether the bus is free, and if it is the user can send messages. If two users try to access the bus at the same time, the user with the higher priority level (lowest ID number) has permission to send its message.

Users with the lowest priority level must cancel their data transfer and wait before re-trying to send their message. Data communication is carried out via messages. These messages consist of 1 COB-ID followed by a maximum of 8 bytes of data. The COB-ID, which determines the priority of the message, consists of a function code and a node number. The node number corresponds to the network address of

the device. It is unique on a bus. The function code varies according to the type of message being sent:

- Management messages (LMT, NMT)
- Messaging and service (SDOs)
- Data exchange (PDOs)
- Layer Setting Services (LSS)
- Predefined messages (synchronization, emergency messages)

The absolute rotary encoder supports the following operating modes:

- Polled mode: The position value is only given on request.
- Cyclic mode: The position value is sent cyclically (regular, adjustable interval) on the bus.
- SYNC mode: The position value is sent after a synchronization message (SYNC) is received. The position value is sent every n SYNCs (n ≥ 1).

Other functions (offset values, resolution, etc) can be configured. The absolute rotary encoder corresponds to the class 2 encoder profile (DS 406 in which the characteristics of encoder with CANopen interface are defined). The node number and speed in bauds are determined via rotary switches.

The transmission speed can range from 20kBaud up to 1Mbaud 1Mbaud (30m cable for a maximum speed of 1Mbaud, 1000 m cable for a maximum speed of 10 kbaud). Various software tools for configuration and parameter-setting are available from different suppliers. It is easy to align and program the rotary encoders using the EDS (electronic data sheet) configuration file provided.

Further CAN-information is available at:

CAN in Automation (CiA) - International Users and Manufacturers Group e.V.
Kontumazgarten 3
DE-90429 Nuremberg
www.**can**-cia.org/

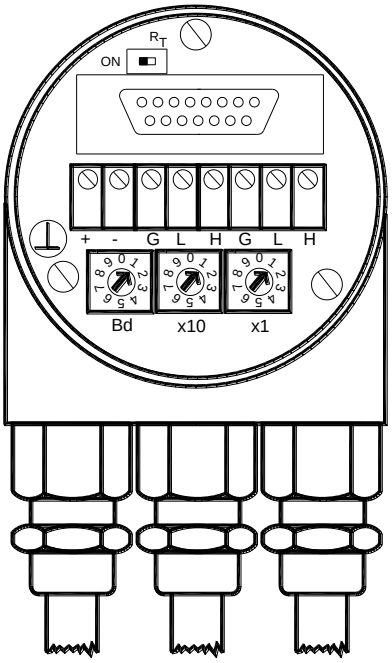
(*) Reference: CAN Application Layer for Industrial Applications
CiA DS201..207 V1.1 CAL-based Communication Profile for Industrial Systems
CiA DS301 CANopen Application Layer
CiA DS406 Device Profile for Encoders

Note: All datasheets and manuals can be downloaded for free from our website www.posital.com

We do not assume responsibility for technical inaccuracies or omissions. Specifications are subject to change without notice.

2. Installation

2.1 Connection via Connection Cap



2.1.1 Signal Assignment

The rotary encoder is connected with two or three cables depending on whether the power supply is integrated into the bus cable or connected separately. If the power supply is integrated into the bus cable, one of the cable glands can be fitted with a plug. The cable glands are suitable for cable diameters from 6.5 up to 9 mm.

Clamp	Description
⊥	Ground
+	24 V Supply voltage
-	0 V Supply voltage
G	CAN Ground
L	CAN Low
H	CAN High
G*	CAN Ground
L*	CAN Low
H*	CAN High

* are not connected, if terminal resistor is ON

(see next page)

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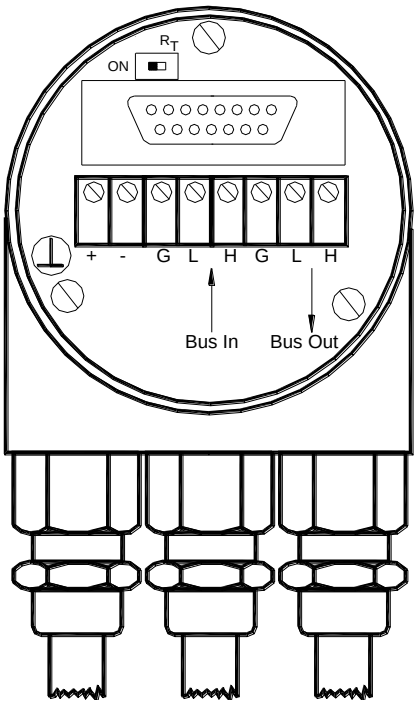


Fig. 1 Connection cap bus in and bus out

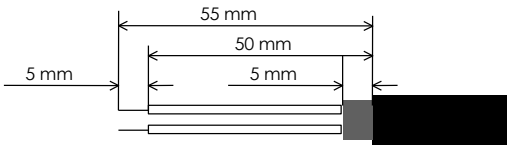


Fig. 2 Cable preparation

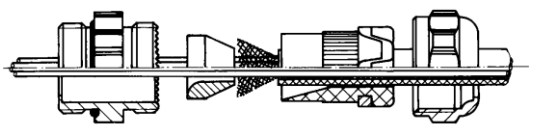


Fig. 3 Cable connection

Bus Connection

The connection cap fulfills the function of a T-coupler. From there the wiring must be done according to the drawing on the left side. Please note the assignment of incoming and outgoing bus signals.

An activated bus termination resistor will lead into a separation of bus in and bus out signals!

Cable Connection

Remove screw, sealing and cone from the cable gland. Remove 55 mm of the sheath and 50 mm of the shielding. About 5 mm of the wires should be de-isolated. Put screw, and sealing on the cable. The cone should be mounted under the shielding according to the figure 3. Put the whole cable into the cable gland and tighten the screw.

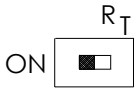
2.1.2 Bus Termination in Connection Cap

If the encoder is connected at the end or beginning of the bus the termination resistor must be switched on. The termination resistor is switched on when the switch is in the ON position.

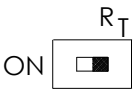
Separation of Bus In and Bus Out signals if termination resistor is activated.

There is a resistor provided in the connection cap, which must be used as a line termination on the last device.

Resistor:



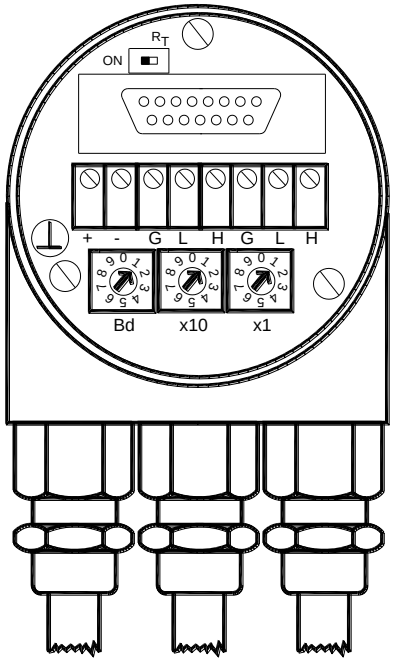
Last Device



Device X

2.1.3 Setting Node Number in Connection Cap

The setting of the node number is done by turning the BCD rotary switches in the connection cap. Possible (valid) addresses lie between 0 and 89 whereby every address can only be used once. Two LEDs on the backside of the connection cap show the operating status of the encoder.



BCD coded rotary switches	
	Device address 0...89
x1	Setting CAN-node number
x10	**Address reserved 90…99**
xBd	Setting of the baud-rate

The CANopen Encoder adds internal 1 to the adjusted device address.

To set the node number the customer can easily remove the connection cap for installation by removing two screws at the backside of the encoder. The meaning and the positioning of the two turn-switches you can see in the picture on the right side.

Protocol Definition via BCD address switches	
x1	**Device address 97**
x10	Recovery of C2-C5-Behavior
x1	**Device address 98**
x10	Protocol selection according to DS301-V3
x1	**Device address 99**
x10	Protocol selection according to DS301-V4

2.1.4 Setting Baudrate in Connection Cap

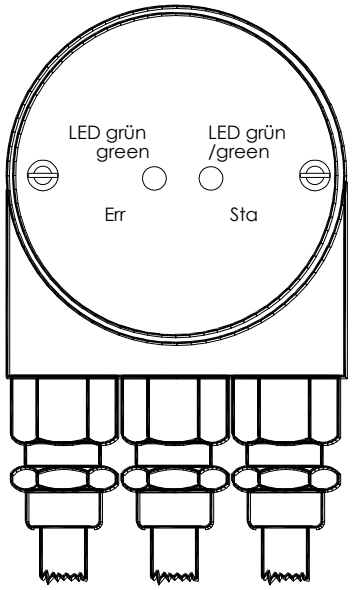
The adjusting of the baudrate is adjusted by one turn switch in the connection cap. The following baudrates are possible:

Baudrate in kBit/s	BCD coded rotary switches
20	0
50	1
100	2
125	3
250	4
500	5
800	6
1000	7
reserved	8
Sets SDO and LSS mode	9

Tab. 2 Baud rate Assignment Connection Cap

2.1.5 Status of the connection cap LEDs

The LED behaviour was designed in accordance to the CiA normative DR 303-3 CANopen indicator specification.



CAN Run LED	State	Description
Flickering	AutoBitrate/ LSS	The auto-bitrate detection is in progress or LSS services are in progress (alternately flickering with run LED)1
Blinking	PREOPERATIONAL	The device is in state PREOPERATIONAL
Single flash	STOPPED	The device is in state STOPPED
Double flash		Reserved for further use
Triple flash	Program/ Firmware download	A software download is running on the device
On	OPERATIONAL	The device is in state OPERATIONAL

Tab.3: CAN Run LED states

ERR LED	State	Description
Off	No error	The device is in working condition
Flickering	AutoBitrate/ LSS	The auto-bitrate detection is in progress or LSS services are in progress (alternately flickering with run LED)1
Blinking	Invalid Configuration	General configuration error
Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
Double flash	Error control event	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred
Triple flash	Sync error	The sync message has not been received within the configured communication cycle period time out (*see* object dictionary entry 1006h)
Quadruple flash	Event-timer error	An expected PDO has not beenreceived before the event-timer elapsed
On	Bus off	The CAN controller is bus off

Tab.4: CAN Error LED states

2.2 Installation of Connector and Cable encoders

The new OCD-II-encoders with cable or connector exit fulfil all connection cap features, like:

- Node Number Addressing
- Baud Rate Setting
- Terminal Resistor

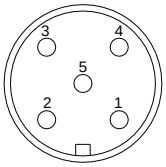
2.2.1 Signal Assignment

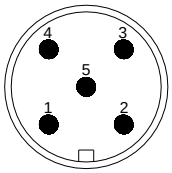
The POSITAL absolute rotary with cable- and connector-exit were designed in accordance to CiA normative DR303-1 cabeling and connector pin assignment.

Signal	5 pin round connector pin number (male / female)	9 pin D-Sub connector pin number	open cable
Signal	Pin	Pin	
CAN Ground	1	3	green
24 V supply voltage	2	9	white
0 V supply voltage	3	6	brown
CAN High	4	7	yellow
CAN Low	5	2	pink

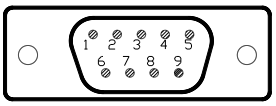
Tab.5 Signal Assignment Connector / Cable

5 pin M12 connector female/male





9 pin D-Sub-connector



2.2.2 Setting Node Number

If the device has a connector, a cable exit or the BCD-rotary-switch in the connection cap is set to “9”, the node number has to be set via SDO objects. An advantage of setting the node number via software is that the whole CANopen node number span from 1 to 127 can be addressed. The default node number is 32. To set node number object 3000h has to be written. For further information regard chapter 5.5 Object Dictionary.

Object 3000h: Node Number

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Node Number	Unsigned 8	1Fh	rw	Yes

NOTE: To avoid the node number 0, one will be added to the value of this object!
E.g.: 1Fh+1h = 20h = 32 (dec)

Setting Node Number via LSS

If the device has a connector, a cable exit or the BCD-rotary-switch in the connection cap is set to “9”, the node number can be adjusted via Layer Setting Services (LSS). For further information regard chapter 4.5

2.2.3 Setting Baud Rate

If the device has a connector, a cable exit or the BCD-rotary-switch in the connection cap is set to “9”, the baud rate has to be adjusted via SDO objects. The default baud rate is 20 kBaud. To set baud rate object 3001h has to be written. For further information please regard chapter 5.5 Object Dictionary.

Eight different baud rates are provided. To adjust the baud rate only one byte is used.

Baudrate in kBit/s	Byte
20	00h
50	01h
100	02h
125	03h
250	04h
500	05h
800	06h
1000	07h

Object 3001h: Baudrate

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Baudrate	Unsigned 8	0h	rw	yes

Setting Baud Rate via LSS

If the device has a connector, a cable exit or the BCD-rotary-switch in the connection cap is set to “9”, the node number can be adjusted via Layer Setting Services (LSS). The default baud rate is 20 kBaud. For further information regard chapter 4.5.

2.2.4 Switching the integrated Bus Terminal Resistor

Object 3002h: Terminal Resistor

This object allows the control of an internal terminal resistor. This resistor can be switched galvanically isolated via an a Photo-MOS-relay.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Terminal resistor	BOOL	0h	rw	yes

If an encoder with connector or cable is used, there is the possibility to set a termination resistor inside the encoder. If the encoder is the last device in the bus, the user can set object 3002h to “one” and the internal termination will be switched on.

3. Technical Data

In the following section you will find general technical datas for OCD absolute rotary encoders with CANopen interface. There are several version with slightly different technical datas. For details please refer to the corresponding datasheet of the used encoder

Electrical Data

Interface	Transceiver according ISO 11898, galvanically isolated by opto-couplers
Transmission rate	max. 1 MBaud
Device addressing	Adjustable by rotary switches in connection cap
Supply voltage	10 – 30* V DC (absolute limits)
Current consumption	max. 230 mA with 10 V DC, max. 100 mA with 24 V DC
Power consumption	max. 2.5 Watts
Step frequency LSB	800 kHz
Accuracy of division	± ½ LSB (12 bit), ± 2 LSB (16 bit)
EMC	Emitted interference: EN 61000-6-4
	Noise immunity: EN 61000-6-2
Electrical lifetime	> 10^5 h

*Absolute rotary encoders should be connected only to subsequent electronics whose power supplies comply with EN 50178 (protective low voltage)

Tab. 6 Electrical Data

Mechanical Data

Flange	**Synchro (S)**		**Clamp (C)**	**Hollow shaft (B)**	**Blind Hollow shaft (T)**
Shaft diameter	6 mm	10 mm	10 mm	15 mm	12 mm
Shaft length	10 mm	20mm	20 mm	-	
hollow shaft depth min. / max.	-	-	-	15 mm / 30 mm	15 mm / -

Tab. 7 Further mechanical data

Housing	Aluminium, optional stainless steel
Lifetime	Dependent on shaft version and shaft loading – refer to table
Max. shaft loading	Axial 40 N, radial 110 N

Inertia of rotor	≤ 30 gcm^2	
Friction torque	≤ 3 Ncm (without shaft sealing)	
RPM (continuous operation)	Singleturn:	max. 12,000 RPM
	Multiturn:	max. 6,000 RPM
Shock (EN 60068-2-27)	≤ 100 g (half sine, 6 ms)	
Permanent shock (EN 60028-2-29)	≤ 10 g (half sine, 16 ms)	
Vibration (EN 60068-2-6)	≤ 10 g (10 Hz ... 1,000 Hz)	
Weight (standard version)	Singleturn:	≈ 300 g
	Multiturn:	≈ 400 g
Weight (with connection cap)	Singleturn:	≈ 500 g
	Multiturn:	≈ 700 g
Weight (stainless steel version)	Singleturn:	≈ 400 g
	Multiturn:	≈ 500 g
Weight (stainless steel version with connection cap)	Singleturn:	≈ 1,100 g
	Multiturn:	≈ 1,200 g

Tab. 8 Further mechanical data

Minimum Mechanical Lifetime

Flange	Lifetime in 10^8 revolutions with F_a / F_r		
	40 N / 60 N	40 N / 80 N	40 N / 110 N
C10 (Clamp flange 10 x 20)	247	104	40
S10 (Synchro flange 10 x 20)	262	110	42
S6 (Synchro flange 6 x 10) without shaft sealing	822	347	133

Tab. 9 Mechanical Lifetime

S6 (Synchro flange 6 x 10) with shaft sealing: max. 20 N axial, 80 N radial

Environmental Conditions

Operating temperature	- 40 .. +85°C
Storage temperature	- 40 .. + 85 °C
Humidity	98 % (without liquid state)
Protection class (EN 60529)	Casing side: IP 65
	Shaft side: IP 64 (optional with shaft sealing: IP66)

Tab. 10 Environmental Conditions

4. Configuration

The purpose of this chapter is to describe the configuration parameters of the absolute rotary encoder with CANopen interface.

4.1 Operating Modes

4.1.1 General

The encoder accesses the CAN network after powerup in pre-operational mode:
BootUp Message: 700 hex + Node Number

It is recommended that the parameters can be changed by the user when the encoder is in preoperational mode. Pre-operational mode entails reduced activity on the network, which simplifies the checking of the accuracy of the sent/received SDOs. It is not possible to send or receive PDOs in pre-operational mode.

4.1.2 Mode: Preoperational

To set a node to pre-operational mode, the master must send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	80 h	00	NMT-PreOp, all nodes
0 h	80 h	NN	NMT-PreOp, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to pre-operational mode. The pre-operational mode can be used for configuration purposes, in this state no Proces Data Objects (PDOs) can be sent by the encoder.

4.1.3 Mode: Start - Operational

To put one or all nodes in the operational state, the master have to send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	01 h	00	NMT-Start, all nodes
0 h	01 h	NN	NMT-Start, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to operational mode. This mode is used for normal operation and the encoder can provide the position value as PDO.

4.1.4 Mode: Stopped

To put one or all nodes in the stopped state, the master have to send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	02 h	00	NMT-Stop, all nodes
0 h	02 h	NN	NMT-Stop, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to stop mode.

4.1.2 Reinitialization of the Encoder

If a node is not operating correctly, it is advisable to carry out a reinitialization:

NN	Command	Index	Description
0 h	82 h	00	Reset Communication
0 h	81 h	NN	Reset Node

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) in reset mode.

After reinitialization, the encoder accesses the bus in pre-operational mode.

4.2 Normal Operating

Polled Mode	By a remote-transmission-request telegram the connected host calls for the current process value. The encoder reads the current position value, calculates eventually set-parameters and sends back the obtained process value by the same identifier.
Cyclic Mode	The encoder transmits cyclically - without being called by the host - the current process value. The cycle time can be programmed in milliseconds for values between 1 ms and 65536 ms.
Sync Mode	After receiving a sync telegram by the host, the encoder answers with the current process value. If more than one node number (encoder) shall answer after receiving a sync telegram, the answer telegrams of the nodes will be received by the host in order of their node numbers. The programming of an offset-time is not necessary. If a node should not answer after each sync telegram on the CAN network, the parameter sync counter can be programmed to skip a certain number of sync telegrams before answering again.

Tab. 11 CAN Transmission Mode Description

4.3 Storing Parameter

4.3.1 List of storable Parameter

Object Index	Object Description
1005h	COB-ID Sync
100Ch	Guard Time
100Dh	Life Time Factor
1016h	Consumer Heartbeat Time
1017h	Producer Heartbeat Time
1020h	Verify configuration
1800h	Communication parameter PDO 1
1801h	Communication parameter PDO 2
1A00h	Transmit PDO1 Mapping Parameter
1A01h	Transmit PDO2 Mapping Parameter
2100h	Operating Parameters
2101h	Resolution per Revolution
2102h	Total Resolution
2103h	Preset Value
2104h	Limit Switch, min.
2105h	Limit Switch, max.
2160h	Customer Storage
2200h	Cyclic Timer
3000h	Node Number
3001h	Baud rate
3002h	Terminal Resistor
3030h	C2-C5-Behavior
6000h	Operating Parameter
6001h	Steps per Revolution
6002h	Total Resolution
6003h	Preset Value
6200h	Cyclic Timer

Tab. 12 List of Storable Parameters

4.3.1 Storing Procedure

The parameter settings can be stored in a non-volatile E^2PROM. The parameter settings are stored in RAM when being programmed. When all the parameters are set and proved, they can be transferred in one burn cycle to the E^2PROM by the parameter memory transfer. The stored parameters are copied after a RESET (Power on, NMT-Reset) from the E^2PROM to the RAM (volatile memory).

Storing without Reset

By using the object 1010h from the communication profile related object dictionary you can store the parameters into the non-volatile memory without a reset.

Storing with Reset

By using the object 2300h from the manufacturer specific object dictionary you can store the parameters into the non-volatile memory. After storing the parameters a reset of the device is performed.

4.4 Restoring Parameters

The default parameters can be restored by using the object 1011h from communication profile related object dictionary. The already in the non-volatile memory programmed parameters are not overwritten. Only after a new store command the default parameters are stored in the non-volatile memory. To restore the default parameter the following telegram is used. The restored parameters are equal for every type of CANopen encoder and might not fit with the status after delivery. Please check the restored parameters before you store them to the non-volatile memory.

4.5 Usage of Layer Setting Services (LSS)

The integrated Layer Setting Service functionality is designed according to the CiA normative DS305V200 CANopen Layer Setting Service: General Description:

These services and protocols can be used to inquire or to change settings of several parameters of the physical, data link layer, and application layer on a CANopen device with LSS slave capability by a CANopen device with LSS master capability via the CAN network. In case of the OCD-II-series, the encoder will be the LSS slave device and the PLC (control) has to support LSS master device functionality. The LSS-functionality of the OCD-II-series is limited to the following parameters of the application layer, namely node number and baud rate.

Object 1018h: Identity Object (LSS-address)

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of entries	Unsigned 8	4	ro	no
1	Vendor ID	Unsigned 32	42h	ro	no
2	Product Code	Unsigned 32	43h 41h	ro	no
3	Revision Number	Unsigned 32	10000h	ro	no
4	Serial Number	Unsigned 32		ro	no

Tab. 13: Identity Object

The LSS master device requests services that are performed by the encoder (LSS slave devices). The LSS master device requests the LSS address from the LSS slave device. The LSS address is defined in object 1018h Identity Object - it consists of vendor-id, product-code, revision-number and serial-number as shown in Table 10. After receiving this information the control can unequivocally identify the encoder and the node number and baud rate can be set. The exact procedure varies in detail, coursed by the different PLC tools.

5. Programmable Parameters

Objects are based on the CiA 406 DS V3.2: CANopen profile for encoders (www.can-cia.org)

Command	Function	Telegram	Description
22h	Domain Download	Request	Parameter to Encoderr
23h, 27h, 2Bh, 2Fh (*)	Domain Download	Request	Parameter to Encoder (Bytes indicated)
60h	Domain Download	Confirmation	Parameter received
40h	Domain Upload	Request	Parameter request
43h, 47h, 4Bh, 4Fh (*)	Domain Upload	Reply	Parameter to Master (Bytes indicated)
80 h	Warning	Reply	Transmission error

(*)The value of the command byte depends on the data length of the called parameter.

Tab. 14 General Command Byte Description

Command	Data length	Data type		Command	Data length	Data type
43h	4 Byte	Unsigned 32		23h	4 Byte	Unsigned 32
47h	3 Byte	Unsigned 24		27h	3 Byte	Unsigned 24
4Bh	2 Byte	Unsigned 16		2Bh	2 Byte	Unsigned 16
4Fh	1 Byte	Unsigned 8		2Fh	1 Byte	Unsigned 8

Tab. 15 Detailed Command Byte Description

Object Dictionary

The data transmission according to CAL is realized exclusively by object oriented data messages. The objects are classified in groups by an index record. Each index entry can be subdivided by sub-indices. The overall layout of the standard object dictionary is shown beside:

Index (hex)	Object
0000	not used
0001-001F	Static Data Types
0020-003F	Complex Data Types
0040-005F	Manufacturer Specific Data Types
0060-0FFF	Reserved for further use
1000-1FFF	Communication Profile Area
2000-5FFF	Manufacturer Specific Profile Area
6000-9FFF	Standardized Device Profile Area
A000-FFFF	Reserved for further use

Tab. 16 Overview Object Dictionary

5.1 Programming example: Preset Value

If a CANopen device is connected and configured by the turning switches with the right baudrate and also configured to a unused node number, it will start up into the pre-operational mode and send a bootup massage to the master. The RUN LED of the device is now blinking.

5.1.1 Set Encoder Preset Value

Master to Encoder with Node Number 1

Setting Preset Value (Value 1000)

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	03	60	00	00	10	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	00	00	00

Read Preset Value from the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	40	03	60	00	00	00	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	10	00	00

Save Preset Values

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	1010h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	10	10	01	73	61	76	65

5.2 Communication Profile DS301 specific objects from 1000h - 1FFFh

In this manual we refer to the communication profile DS301 V4.02

Object	Description	Page Hand-Book	Page DS301	Page DS406
1000h	Device type	22	86	8
1001h	Error register	22	87	8
1003h	Pre-defined error field	22	88	
1005h	COB-ID SYNC-message	23	89	
1006h	ComCyclePeriode	23	90	
1008h	Device name	24	91	
1009h	Hardware version	24	91	
100Ah	Software version	24	91	
100Ch	Guard Time	24	92	
100Dh	Life Time Factor	24	92	
1010h	Store parameters	25	92	
1011h	Restore default parameters	25	94	
1012h	COB-ID Time Stamp	26	97	
1013h	High Resolution Time Stamp	26	98	
1014h	COB-ID Emergency	26	98	
1016h	Consumer Heartbeat Time	26	100	
1017h	Producer Heartbeat Time	27	101	
1018h	Identity Object	27	101	
1020h	Verify Configuration		117	
1029h	Error Behaviour		133	9
1800h	Communication parameter PDO 1	28	111	9
1801h	Communication parameter PDO 2	28	111	11
1A00h	Transmit PDO1 Mapping Parameter	30	112	11
1A01h	Transmit PDO2 Mapping Parameter	30	112	12
1F50h	Download Program Area			
1F51h	Program Control			

Tab. 17 Object Dictionary 1000h-1FFFh

5.3 Manufacturer specific objects 2000h – 5FFFh

Object	Description	Page Hand-Book
2000h	Position Value	31
2100h	Operating Parameters	31
2101h	Resolution per Revolution	31
2102h	Total Resolution	33
2103h	Preset Value	34
2104h	Limit Switch, min.	34
2105h	Limit Switch, max.	33
2160h	Customer Storage	35
2200h	Cyclic Timer	35
2300h	Save Parameter with reset	35
3000h	Node Number	36
3001h	Baudrate	36
3010h	Speed Control	37
3011h	Speed Value	37
3020h	Acceleration Control	37
3021h	Acceleration Value	37
4000h	Bootloader Control	38

Tab. 18 Object Dictionary 2000-5FFF

5.4 Application specific objects 6000h – 67FEh

In this manual we refer to the communication profile DS406 V3.2

Object	Description	Page Hand-Book	Page DS406
6000h	Operating Parameters	38	17
6001h	Measuring units per revolution	38	18
6002h	Total measuring range in measuring units	39	19
6003h	Preset value	39	19
6004h	Position Value	40	20
6030h	Speed Value	40	25
6040h	Acceleration Value	40	26
6200h	Cyclic Timer	40	28
6300h	Cam state register	40	30

6301h	Cam enable register	41	32
6302h	Cam polarity register	41	33
6400h	Area state register	44	
6401h	Work area low limit	44	
6402h	Work area high limit	44	
6500h	Operating status	45	63
6501h	Singleturn resolution	45	64
6502h	Number of distinguishable revolutions	45	65
6503h	Alarms	46	65
6504h	Supported alarms	46	66
6505h	Warnings	47	67
6506h	Supported warnings	47	68
6507h	Profile and software version	48	69
6508h	Operating time	48	70
6509h	Offset value	49	70
650Ah	Module identification	49	71
650Bh	Serial number	49	72

Tab. 19 Object Dictionary 6000h-6FFFh

5.5 Object Descriptions

In the following chapter you will find detailed information of the object dictionary related to the encoder device.

Object 1000h: Device Type

The object at index 1000h describes the type of device and its functionality. It is composed of a 16-bit field which describes the device profile that is used and a second 16-bit field which gives additional information about optional functionality of the device. The additional information parameter is device profile specific.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	N/A	ro	no

OCD absolute rotary encoder singleturn: 10196h

OCD absolute rotary encoder multiturn: 20196h

Object 1001h: Error Register

This object is used by the device to display internal faults. When a fault is detected, the corresponding bit is therefore activated.

The following errors are supported:

Bit	Description	Comments
0	Generic Error	The generic error is signaled at any error situation.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	-	Unsigned 8	N/A	ro	no

Object 1003h: Pre-Defined Error Field

The object holds the errors that have occurred on the device and have been signaled via the Emergency Object.

- The error code is located in the least significant word
- Additional Information is located in the most significant word
- Subindex 0 contains the number of recorded errors

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of recorded errors	Unsigned 8	0	rw	no
1	Most recent errors	Unsigned 32	-	ro	no
2	Second to last error	Unsigned 32	-	ro	no
…					
10					

Clearing Error Log

The error log can be cleared by writing 0 to subindex 0 of object 1003.

Object 1005h: COB-ID Sync

This object contains the synchronization message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80000080h	rw	no

Object 1008h: Manufacturer Device Name

This object contains the device name.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

Object 1009h: Manufacturer Hardware Version

This object contains the article name of the circuit board.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

There are two actual versions of circuit boards for OCD:

- POS026

Object 100Ah: Manufacturer Software Version

This object contains the manufacturer software version. The new encoder line 2008 starts with version 4.00.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	4.00	ro	no

Object 100Ch: Guard Time

This object contains the guard time in milliseconds.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 16	0	rw	yes

Object 100Dh: Life Time Factor

This object contains the life time factor parameters. The life time factor multiplied with the guard time gives the life time for the node guarding protocol.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 8	0	rw	yes

Object 1010h: Store Parameters

This object is used to store device and CANopen related parameters to non volatile memory.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	Store all parameters	Unsigned 32	“save”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “save” has to be sent to the corresponding subindex of the device.

	Most significant word		Least significant word	
ASCII	E	v	a	s
Hex value	65h	76h	61h	73h

Object 1011h: Restore Parameters

This object is used to restore device and CANopen related parameters to factory settings.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	Restore all parameters	Unsigned 32	“load”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “load” has to be sent to the corresponding subindex of the device.

	Most significant word		Least significant word	
ASCII	D	a	o	l
Hex value	64h	61h	6Fh	6Ch

Note: The restoration of parameters will only be taken into account after a power up or reset command. Please check all parameters before you store them to the non volatile memory.

Object 1012h: COB-ID Time Stamp Object

This object contains the COB-ID of the Time Stamp object.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	100h	rw	no

Object 1013h: High Resolution Time Stamp

This object contains a time stamp with a resolution of 1µs.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	0	rw	no

Object 1014h: COB-ID Emergency Object

This object contains the EMCY emergency message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80h + Node ID	rw	no

Object 1016h: Consumer Heartbeat Time

The consumer heartbeat time defines the expected heartbeat cycle time in ms. The device can only monitor one corresponding device. If the time is set to 0 the monitoring is not active. The value of this object must be higher than the corresponding time (object 1017) of the monitored device.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of indices	Unsigned 8	1	ro	no
1h	Consumer heartbeat time	Unsigned 32	0	rw	yes

The context of subindex 1 is as follows:

Bit	31 to 24	23 to 16	15 to 0
Value	0h (reserved)	Address of monitored device	Monitoring time (ms

Object 1017h: Producer Heartbeat Time

The object contains the time intervall in milliseconds in which the device has to produce the a heartbeat message.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	-	Unsigned 16	0	rw	yes

Object 1018h: Identity Object

This object contains the device information. For further information, please see chapter 4.5 Layer Setting Services.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of entries	Unsigned 8	4	ro	no
1h	Vendor ID	Unsigned 32	42h	ro	no
2h	Product Code	Unsigned 32	43h 41h	ro	no
3h	Revision Number	Unsigned 32	10000h	ro	no
4h	Serial Number	Unsigned 32		ro	no

Object 1020h: Verify configuration

This object indicates the downloaded configuration date and time.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of entries	Unsigned 8	2h	ro	no
1h	Configuration date	Unsigned 32		rw	no
2h	Configuration time	Unsigned 32		rw	no

Object 1029h: Error behaviour

This object indicates the error behavior.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of entries	Unsigned 8	1h	ro	no
1h	Communication error	Unsigned 8		rw	no

Object 1800h: 1st TPDO Communication Parameter

This object contains the communication parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	180h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	FE	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	64h or 0	rw	yes

Object 1801h: 2nd TPDO Communication Parameter

This object contains the communication parameter of the 2nd transmit PDO. NOTE: In the older encoder line C2 and C5 the second PDO was configured via object 1802!

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	280h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	1	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	0	rw	yes

Transmission Mode

The transmission mode can be configured as described below:

Transfer Value (decimal)	Transmission Mode					Notes
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only	
0		X	X			Send PDO on first Sync message following an event
1-240	X		X			Send PDO every x Sync messages
241-251	reserved					
252			X		X	Receive SYNC message and send PDO

						on Remote Request
253					X	Update data and send PDO on Remote Request
254				X		Send PDO on event
255				X		Send PDO on event

Inhibit Time

For "Transmit PDOs", the "inhibit time" for PDO transmissions can be entered in this 16 bit field. If data is changed, the PDO sender checks whether an "inhibit time" has expired since the last transmission. A new PDO transmission can only take place if the "inhibit time" has expired. The "inhibit time" is useful for asynchronous transmission (transmission mode 254 and 255), to avoid overloads on the CAN bus.

Event Timer

The "event timer" only works in asynchronous transmission mode (transmission mode 254 and 255). If the data changes before the "event timer" expires, a temporary telegram is sent. If a value > 0 is written in this 16-bit field, the transmit PDO is always sent after the "event timer" expires. The value is written in subindex 5 of a transmit PDO. The data transfer also takes place with no change to data. The range is between 1-65536 ms.

Object 1A00h: 1st TPDO Mapping Parameter

This object contains the mapping parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	yes
1	1st mapped object	Unsigned 32	60040020h	rw	yes

Object 1A01h: 2nd TPDO Mapping Parameter

This object contains the mapping parameter of the 2nd transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	yes
1	2nd mapped object	Unsigned 32	60040020h	rw	yes

Object 1F50h: Download Program Area

This is a special bootloader object that has functionality for singleturn encoders without connection cap only. (see Bootloader chapter)

Use this entry to download your Intel hex file with the programming data. Detailed information about Domain download and Block transfer in CiA Draft Standard 301 Application Layer and communication Profile.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	ro	Yes
1h		DOMAIN		wo	yes

Object 1F51h: Program Control

This is a special bootloader object that has functionality for single turn encoders without connection cap only (see Bootloader chapter).

This array controls the programs residing at index 0x1F50.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of program control entries	Unsigned 8	2h	ro	yes
1h		Unsigned 32		rw	yes

Sub-index 1h and higher control the memory block functionality. They can have the following values:

for writing:

1 - start downloaded program

4 - erase flash

Object 2000h: Position Value

This object contains the position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Position Value	Unsigned 32	-	ro	n.a.

Object 2100h: Operating Parameters

As operating parameters the code sequence (Complement) can be selected and the limit switches can be turned on or off.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Operating Parameters	Unsigned 8	0h	rw	yes

The parameter code sequence (Complement) determines the counting direction, in which the output process value increases or decreases (CW = Clockwise, CCW = Counterclockwise). The code sequence is determined by Bit 0 in Index 2100h. Additionally, the two limit switches, Min. and Max. can be turned on or off in Index 2100h. Optional an event triggered PDO can be activated. Remark: This function produces a PDO with every change of the position value. Due to this, there will be generated a large amount of PDOs and a heavy bus load.

Bit 0	Code sequence	Code	Bit 1	Limit switch, min.	Bit 2	Limit switch, max.	Bit 3	Event triggered PDO
0	CW	increasing	0	off	0	off	0	off
1	CCW	increasing	1	on	1	on	1	on

Calculation Example: Target: Absolute rotary encoder with direction CCW decreasing, both limit switches disabled and event-triggered PDOs enabled.

Bitmatrix:

Bit 0 = 1 Direction decreasing (CCW)

Bit 1 = 0 Limit switch min. disabled

Bit 2 = 0 Limit switch max. disabled

Bit 3 = 1 Event triggered

Result = 1001h

Object 2101h: Resolution per Revolution

This object contains the desired steps per revolution of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Resolution per Revolution	Unsigned 32	see type sign	rw	yes

If the desired value exceeds the hardware resolution of the encoder, the code will not be transmitted stepwise. So it is important, to keep the parameter in the possible value range.

Object 2102h: Total Resolution

This object contains the desired total resolution of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Total Resolution	Unsigned 32	see type sign	rw	yes

This parameter is used to program the desired number of measuring units over the total measuring range. This value must not exceed the total resolution of the absolute rotary encoder, which is printed on the type sign of the encoder.

Attention:

Following formula letter will be used:

PGA	Physical total resolution of the encoder	(see type sign)
PAU	Physical resolution per revolution	(see type sign)
GA	Total resolution (customer parameter)	
AU	Resolution per revolution (customer parameter)	

Please use the following formula to calculate the total resolution of the encoder:

$$GA = \frac{(PGA * AU)}{PAU}, AU \leq PAU \qquad k = \frac{PGA}{GA}, k = \text{ganze Zahl}$$

If the desired resolution per revolution is less than the really physical resolution per revolution of the encoder, then the total resolution must be entered as follows:

Total resolution:

Calculation example:

Customer handicap: AU = 2048

Encoder type sign:

PGA=24 bit, PAU=12bit

$$GA = \frac{(16777216 * 2048)}{4096}$$

$$GA = 8388608$$

Object 2103h: Preset Value

The preset value is the desired position value, which should be reached at a certain physical position of the axis. The position value is set to the desired process value by the parameter preset. The preset value must not exceed the parameter total resolution to avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Preset Value	Unsigned 32	0	rw	yes

Object 2104h: Limit Switch, min.

Two position values can be programmed as limit switches. By reaching this value, one bit of the 32 bit process value is set to high. Both programmed values must not exceed the parameter total resolution to avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Bit 30 = 1: Limit Switch, Min. reached or passed under

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Limit Switch, min.	Unsigned 32	0	rw	yes

The limit switch, Min sets Bit 30=1 with the next message telegram, if the process value reaches or passes under the value of the limit switch:

Function	Status bits		Process value																												
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Bit 31 = 1: Limit Switch, Max. reached or passed beyond

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Limit Switch, max.	Unsigned 32	0	rw	yes

The limit switch, max sets Bit 31=1 with the next message telegram, if the process value reaches or passes under the value of the limit switch:

Function	Status bits		Process value																												
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Object 2160h: Customer storage

This object provides for the customer the possibility to store any value. Attention: The values, written to these objects, will be stored in volatile memory, only.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	4h	ro	
1h	Customer Storage1	Unsigned 32		rw	
2h	Customer Storage2	Unsigned 32		rw	
3h	Customer Storage3	Unsigned 32		rw	
4h	Customer Storage4	Unsigned 32		rw	

Object 2200h: Cyclic Timer PDO

This object contains cyclic time of the event timer in ms (of PDO 1).

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Event Time in ms	Unsigned 16	0h	ro	yes

The object 2200h is hard-wired to the objects 1800h subindex 5h and 6200h and provide the cycle time for the cyclic mode. (See chapter Cycle Time and Event Timer)

Object 2300h: Save Parameter with Reset

With this object all parameters can be stored in the non volatile memory. After storing the parameters a reset is executed.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Access code	Unsigned 32	55AAAA55h	wo	no

Object 3000h: Node Number

This object contains the node number of the device. The POSITAL standard node number is 32.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Node Number	Unsigned 8	1Fh	rw	Yes

NOTE: To avoid the node number 0, one will be added to the value of this object!
E.g.: 1Fh+1h = 20h = 32 (dec)

Object 3001h: Baudrate

This object contains the baudrate of the device.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Baudrate	Unsigned 8	-	rw	yes

Eight different baud rates are provided. To adjust the baud rate only one byte is used.

Baudrate in kBit/s	Byte
20	00h
50	01h
100	02h
125	03h
250	04h
500	05h
800	06h

1000	07h

Object 3002h: Terminal Resistor

This object allows the control of an internal terminal resistor. This resistor can be switched galvanically isolated via a Photo-MOS-relay.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Terminal resistor	BOOL	0h	rw	yes

Object 3010h: Speed Control

This object contains the speed control. The speed measurement is disabled by default.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	ro	
1h	Enable Speed	Unsigned 8	0h	rw	yes
2h	Speed modus	Unsigned 8	0h	rw	yes

Object 3011h: Speed Value

This object contains speed value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Speed value	INTEGER32		romap	no

Speed-modus setting	Delay [msec]	Accuracy [steps/sec], relative
0	5	+/-32; 3.5%
1	50	+/-16; 1.0%
2	500	+/-8; 0.3%

Tab. 20 Delay and accuracy

Object 3020h: Acceleration Control

This object contains the acceleration control. The acceleration measurement is disabled by default.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	Ro	
1h	Enable Acceleration	Unsigned 8	0h	rw	Yes
2h	Acceleration modus	Unsigned 8	0h	rw	yes

Object 3021h: Acceleration Value

This object contains acceleration value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Acceleration Value	INTEGER32		romap	

Acceleration-modus setting	Delay [msec]	Accuracy [steps/sec²]
0	40	+/-1’024
1	120	+/-512
2	750	+/-128

Tab. 21 Delay and accuracy

Object 3030h: C2-C5-Behavior

This object allows to switch back in an backward compatibility mode. To switch back the security code “47111147h“ has to be written to Subindex 0h. After this the Subindex 1h Enable C2-C5-Behavior can be written to ONE. This modus should only be used for fully compatible replacement of C2- or C5-encoders. For further information, concerning compatibility, have a look at Apendix B

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Security code	Unsigned 32	47111147h	ro	
1h	Enable C2-C5-Behavior	BOOL	0h	rw	yes

Object 4000h: Bootloader Control

This object controls the Bootloader functionality. Writing the security code to this object causes erasing the EEPROM and application information in the flash memory and resets the device. After a power-up, the Bootloader checks the user application and detects no more information. The Bootloader starts up with a pre-defined CANopen node ID of 1 (0x1) and a fixed CAN baud rate of 125 kbits.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Bootloader Control	Unsigned32		wo	

ATTENTION:
Activating the boot loader courses a deep reset of the device. If the encoder enters boot loader mode, only a minimum object amount will remain, to assure basic communication. The device does not behave like an encoder anymore and waits for new programming.
Firmware updates have to be done in close cooperation with the CAN product manager of POSITAL.

Object 6000h: Operating parameters

This object shall indicate the functions for code sequence, commissioning diagnostic control and scaling function control.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operating Parameter	Unsigned 16	0h	rw	yes

Code sequence: The code sequence defines, whether increasing or decreasing position values are output, in case the encoder shaft rotates clockwise or counter clockwise as seen from the point of view of the shaft.

Scaling function control: With the scaling function the encoder numerical value is converted in software to change the physical resolution of the encoder. The measuring units per revolution (object 6001h) and total measuring range in measuring units (object 6002h) are the scaling parameters. The scaling function bit is set in the operating parameters. If the scaling function bit is set to zero, the scaling function is disabled.

Bit structure for the operating parameters

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	MD	SFC	CD	CS

Table Description:

MS: Manufacturer Specific Function (not available)

R: Reserved for future use

MD: Measuring direction (not available)

SFC: Scaling function (0 = disable, 1 = enable)

CD: Commissioning diagnostic control (not availabe)

CS: Code sequence (0 = CW, 1 = CCW)

Code Sequence (CS Bit 0) is hardwired to Code Sequence (CS Bit 0) in object 2100h.

Object 6001h: Measuring units per revolution

This object shall indicate the number of distinguishable steps per revolution.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Measuring units per revolution	Unsigned 32	see type sign	rw	yes

Hardwired with 2101h.

Object 6002h: Total measuring range in measuring units

This object shall indicate the number of distinguishable steps over the total measuring range.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Total measuring steps	Unsigned 32	see type sign	rw	yes

Object 6003h: Preset value

This object indicates the preset value for the output position value

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Preset Value	Unsigned 32	0h	rw	yes

Object 6004h: Position value

This object contains the process value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Process Value	Unsigned 32	-	romap	yes

Hardwired with Object 2000h.

Object 6030h: Speed Value

This object contains the speed value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Speed value channel1	Integer 16	-	romap	yes

If the velocity exceeds the data type, the speed value is frozen to the maximal possible value.
The customer can use the 3010h (32 bit) object.

How to map the speed into TPDO2:

(Hint: SDO: 0x600 + Node number. The following values are all in hex and the Nodenumber is "1" DLC (Data length) = 8 , 22 means "write", This example is written in intel-format (LSB...MSB). Depending on your tool, it could be, that the Motorola-format (MSB..LSB) is used and the direction of the Bytes has to be changed.)

1. The TPDO2 has to be enabled by setting the Transmission type (1801Sub2) to FE:
601 8 22 01 18 02 FE 00 00 00

2. The Event Timer has to be changed from 0x00 to the desired value (e.g.: 100 ms --> 0x64)
601 8 22 01 18 05 64 00 00 00

3. The TPDO mapping Parameter 0 (1A01) has to be dissabled, by setting the Number of entries (1A01Sub0) to 0:
601 8 22 01 1A 00 00 00 00 00

4. Then the dissabled TPDO mapping Parameter 0 Subindex 1, namely mappedObj1, can be written. The Speed values is Object 6030Sub1 and the data length is 16Bit --> 10:
601 8 22 01 1A 01 10 01 30 60

5. The TPDO mapping Parameter 0 (1A01) has to be enabled, by setting the Number of entries (1A01Sub0) to 1, again:
601 8 22 01 1A 00 01 00 00 00

6. Finally the Speed has to be enabled by setting "Enable Speed" (3010Sub1):
601 8 22 10 30 01 01 00 00 00

7. To save this configuration please write 73 61 76 65 to 1010:
601 8 22 10 10 01 73 61 76 65

8. Send the NMT-message, to get into "Operational Mode":
00 2 01 00

Summarisation:
601 8 22 01 18 02 FE 00 00 00
601 8 22 01 18 05 64 00 00 00
601 8 22 01 1A 00 00 00 00 00
601 8 22 01 1A 01 10 01 30 60
601 8 22 01 1A 00 01 00 00 00
601 8 22 10 30 01 01 00 00 00
601 8 22 10 10 01 73 61 76 65
00 2 01 00

Object 6040h: Acceleration Value

This object contains the acceleration value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Acceleration value channel1	Integer 16	-	romap	yes

Object 6200h: Cyclic timer

This object contains the value of the event timer of the corresponding TPDOs. The value can be changed between 1-65538 ms.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Cyclic Time	Unsigned 16	64h	rw	yes

The object 6200h is hard-wired to the objects 1800h (subindex 5h and 2200h) and provides the cycle time for the cyclic mode. (See chapter Cycle Time and Event Timer)

Object 6300h: Cam state register

This object contains the cam state register. The subindices 1h to FEh containing the cam state of channel 1 to 254.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam state channel 1	Unsigned 8	4h	romap	yes

Object 6301h: Cam enable register

This object contains the cam enable register

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam enable channel 1	Unsigned 8		rw	yes

Object 6302h: Cam polarity register

This object contains the cam enable register

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp

0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam polarity channel 1	Unsigned 8	0h	rw	yes

List of Cam objects						
6310h			Cam1 low limit		rw	
	0h	VAR	Highest sub-index supported	U32	ro	0x1
	1h	VAR	Cam1 low limit channel1		rw	
6311h			Cam2 low limit		rw	
	0h	VAR	Highest sub-index supported	U32	ro	0x1
	1h	VAR	Cam2 low limit channel1		rw	
6312h			Cam3 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 low limit channel1		rw	
6313h			Cam4 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 low limit channel1		rw	
6314h			Cam5 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 low limit channel1		rw	
6315h			Cam6 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 low limit channel1		rw	
6316h			Cam7 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 low limit channel1		rw	
6317h			Cam8 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 low limit channel1		rw	
6320h			Cam1 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam1 high limit channel1		rw	
6321h			Cam2 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam2 high limit channel1		rw	
6322h			Cam3 high limit		rw	

	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 high limit channel1		rw	
6323h			Cam4 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 high limit channel1		rw	
6324h			Cam5 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 high limit channel1		rw	
6325h			Cam6 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 high limit channel1		rw	
6326h			Cam7 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 high limit channel1		rw	
6327h			Cam8 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 high limit channel1		rw	
6330h			Cam1 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam1 hysteresis channel1		rw	
6331h			Cam2 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam2 hysteresis channel1		rw	
6332h			Cam3 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 hysteresis channel1		rw	
6333h			Cam4 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 hysteresis channel1		rw	
6334h			Cam5 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 hysteresis channel1		rw	
6335h			Cam6 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 hysteresis channel1		rw	
6336h			Cam7 hysteresis		rw	

	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 hysteresis channel1		rw	
6337h			Cam8 hysteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 hysteresis channel1		rw	

Object 6400h: Area state register

This object contains the area state register

The object provides the actual area status of the encoder position. Figure 9 specifies the object structure and Table 106 specifies the value definition.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Work area state channel	Unsigned 8		romap	yes

7	6	5	4	3	2	1	0
R	r	r	r	r	Range underflow	Range overflow	Out of range
MSB							LSB

Signal	Value	Definition
out of range	0 1	Position between low and high limit Position out of range (refer to module identification object, 650Ah) is reached
range overflow	0 1	No range overflow Position is lower than the position value set in object 6402h „work area low limit“
range underflow	0 1	No range underflow Position is higher than the position value set in object 6401h „work area high limit“
r	0	Reserved

Object 6401h: Work area low limit

This object indicates the position value, at which bit 2 of the according work area state channel in object 6400h shall flag the underflow of the related work area.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Integer 32	1h	ro	
1h	Work area low limit channel 1	Integer 32	0h	rw	yes

This object is hardwired with 2104h (Limit Switch Min).

Object 6402h: Work area high limit

This object indicates the position value, at which bit 1 of the according work area state channel in object 6400h shall flag the overflow of the related work area.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Integer 32	1h	ro	
1h	Work area high limit channel 1	Integer 32	0h	rw	yes

This object is hardwired with 2105h (Limit Switch Max).

Object 6500h: Operating status

This object shall provide the operating status of the encoder. It gives information on encoder internal programmed parameters.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operating status	Unsigned 16	-	ro	no

The operating status object corresponds to the value of the object 6000h and 2100h.

Object 6501h: Single-turn resolution

The object contains the physical measuring steps per revolution of the absolute rotary encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Single Turn Resolution	Unsigned 32	see type sign	ro	no

Object 6502h: Number of distinguishable revolutions

This object contains number of revolutions of the absolute rotary encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of Revolutions	Unsigned 16	see type sign	ro	no

Object 6503h: Alarms

Additionally to the emergency messages in /CiA301/, this object shall provide further alarm messages. An alarm shall be set if a malfunction in the encoder could lead to incorrect position value. If an alarm occurs, the according bit shall indicate the alarm til the alarm is cleared and the encoder is able to provide an accurate position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Alarms	Unsigned 16	-	romap	no

Bit structure of the alarms

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	R	R	CD	PE

Table Description:

MS: Manufacturer Specific Alarm (not supported)

R: Reserved for future use

CD: Commissioning diagnostic control (not supported)

PE: Position Error (not supported)

Object 6504h: Supported alarms

The object shall provide the supported alarms of the device. Please refer to the bit structure table to find more details about the supported alarms.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Supported Alarms	Unsigned 16	1000h	ro	no

The CA-encoder supports the position error alarm.

Object 6505h: Warnings

This object shall provide the warnings. Warnings indicate that tolerance for certain internal parameters of the encoder have been exceeded. In contrast to alarm and emergency messages warnings do not imply incorrect position values. All warnings shall be cleared if the tolerances are again within normal parameters.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Warnings	Unsigned 16	-	romap	no

Bit structure of the warnings

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	RP	BC	OT	CP	LC	FE

Table Description:

MS: Manufacturer Specific Warnings (not supported)
R: Reserved for future use
RP: Reference Point reached/not reached (not supported)
BC: Battery charge (not supported)
OT: Operating Time limit (not supported)
CP: CPU watchdog status (not supported)
LC: Light control reserve (not supported)
FE: Frequency warning (not supported)

Object 6506h: Supported warnings

The object provides the supported warnings of the device. Please refer to the bit structure table to find more details about the supported warnings.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp

0h	Supported Warnings	Unsigned 16	1000h	ro	no

Currently there are not supported warnings available for an Optocode absolute rotary encoder.
The CA-encoder supports the manufacture specific warning (Bit 12).

Object 6507h: Profile and software version

This object provides the implemented encoder device profile version and the manufacturer-specific software version.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Profile and Software Version	Unsigned 32	04040302h	ro	no

The value is divided into the profile version part and the Software version part. Each part is divided in upper version and lower version.
MSB

LSB

Software Version 4.4		Profile Version 3.2	
Upper Software Version	Lower Software Version	Upper Profile Version	Lower Profile Version
04	04	03	02

Object 6508h: Operating time

This object indicates the operating time of the device. Currently the operating time is not supported and the value of this object will always be FFFFFFFFh.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operatiung time	Unsigned 32	FFFFFFFFh	ro	no

Object 6509h: Offset value

This object contains the offset value. It is been calculated by the preset function and shifts the physical position value with the desired value.

Subindex	Description	Data Type	Default Value	Access	Restore after

					BootUp
0h	Offset value	Integer 32	-	ro	no

Object 650Ah: Module identification

This object shall provide the manufacturer-specific offset value, the manufacturer-specific minimum and maximum position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Highest supported subindex	Integer 32	3	ro	no
1h	Manufacturer offset value	Integer 32	-	ro	no
2h	Man. min. position value	Integer 32	-	ro	no
3h	Man. max. position value	Integer 32	-	ro	no

Object 650Bh: Serial number

This object contains the serial number of the device. The serial number is also supported in object 1018h subindex 4h.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Serial Number	Unsigned 32	See type sign	ro	no

6. Troubleshooting

6.1 Power on – Encoder doesn't respond

Problem:
The bus is active but the installed encoder transmitted no boot up message.

Possible solution:

- switch of the PLC
- remove the connection cap of the encoder
- check the turn-switch for the baud rate
- Assemble the connection cap
- power on

6.2 Malfunction of the position value during transmission

Problem:
During the transmission of the position value occasional malfunction occurs. The CAN bus can be temporary in the bus off state also.

Possible solution:
Check, if the last bus node has switched on the terminal resistor. If the last bus node is an encoder the terminal resistor is situated in the connection cap.

6.3 Too many ERROR-Frames

Problem:
The bus load is too high in case of too many error frames.

Possible solution:
Check if all bus nodes have the same baud rate. If one node has another baud rate error frames are produced automatically.

6.4 Limit switches without function

Problem:
The encoder didn't transmit the bits for the limit switches.

Possible solution:
The limit switch functionality has to be activated once. Please follow the description you can find at 4.5.

6.5 Encoder without connection cap

Notice: The changing of baud rate and node number are only valid after a new power up, NMT Reset or the store parameters command.

7. Mechanical Drawings

Refer to the data sheet information on the website www.posital.com.

ABSOLUTE IXARC ROTARY ENCODER
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Appendix A: Order Codes

Description	Type key										
IXARC Optical	**OCD-**	**CA**	**A1**	**B -**	_ _	_ _ -	_	_ _	_-	___
Interface	CANopen	**CA**								
Version			**A1**							
Code	Binary			**B**						
Revolutions (Bits)	Singleturn				**00**					
	Multiturn (4096 revolutions)				**12**					
	Multiturn (16384 revolutions)				14					
Steps per revolution	4096 (0,09°)					**12**				
	8192 (0,04°)					13				
	65536 (0,005°)					16				
Flange	Clamp flange						**C**			
	Synchro flange						**S**			
	Through Hollow Shaft						**T**			
	Blind shaft						**B**			
Shaft diameter	06 mm							**06**		
	10 mm							**10**		
	12 mm (Through Hollow Shaft)							**12**		
	15 mm (Blind Hollow shaft)							**15**		
Mechanical options	without								**0**	
	Shaft sealing (IP66)								S	
	Stainless steel version*								V	
	Customized								C	
Connection										
Connection Caps	Cap encoder with connection cap AH 58-B1CA-3PG									**H3P**
	Cap encoder with connection cap AH 58-B1CA-2M20									H2M
	Cap encoder with connection cap AH 58-B1CA-1BW									H1B
	Cap encoder with connection cap AH 58-B1CA-2BW									H2B
	Cap encoder without connection cap**									HCC
Cable	Cable exit 1m, radial, open wire ends									CRW
	Cable exit 1m, axial, open wire ends									CAW
Connectors	Connector exit, radial, 5 pin male M12									PRM
	Connector exit, axial, 5 pin male M12									PAM
	Connector exit, axial, 9 pin D-Sub									PA9

Standard = bold, further models on request

* Stainless Steel version is not available with radial cable or connector exit (namely CRW, PRM)

** For the function of a cap encoder a connection cap is needed. To order this encoder type only makes sense for spare part / replacement usage

Tab. 22 Order Key

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Connection caps

All connections caps are equipped with a switchable terminal resistor, integrated T-coupler for CAN bus lines, BCD switches to adjust baudrate and node number, as well as LEDs for diagnosis.

Description	Article Name	Article Number
Aluminium housing with three M12 cable glands for cable diameters between 6,5 – 9 mm.	AH 58-B1CA-3PG	0246370325
Stainless steel housing with three M12 cable glands.	AH 58-B1CA-3PG-VA	0246370328
Aluminium housing with one 5 pin male M12 connector.	AH 58-B1CA-1BW	0246370342
Aluminium housing with on 5 pin male M12 connector and one 5 pin female M12 connector	AH 58-B1CA-2BW	0246370370
Aluminium housing with two M20 cable glands for cable diameter between 9 – 13 mm.	AH 58-B1CA-2M20	0246370339

Tab. 23 Available Connection Cap Types

Models/Ordering Description for Heavy Duty Version

Description	**Type key**										
IXARC Optical	**OCD-**	**CA**	**A1**	**B -**	_ _	_ _ -	_	_ _	_-	___
Interface	CANopen	**CA**								
Version			**A1**							
Code	Binary			**B**						
Revolutions (Bits)	Singleturn				**00**					
	Multiturn (4096 revolutions)				**12**					
	Multiturn (16384 revolutions)				14					
Steps per revolution	4096					**12**				
	8192					13				
	65536					16				
Flange	Clamp flange						**C**			
	Synchro flange						**S**			
	Blind shaft						**B**			
Shaft diameter	10 mm							**10**		
	15 mm (Hollow shaft)							**15**		
Mechanical options	without								**H**	
	Customized								C	
Connection	1x 5 pin M12 connector male, 1x 5 pin M12 connector female, venting element									PRN
	1x 5 pin M12 connector male, venting element									PRM

Tab. 24 Order Key for Heavy Duty encoders

Accessories

Description		Article Name	Article Number
Shaft Coupling	Drilling: 10 mm / 10 mm	GS 10	29100450
	Drilling: 6 mm / 6 mm	GS 06	29100350
	Drilling: 4 mm – 11 mm	GS 4-11	29100440
Clamp Disc	Set (4 pieces).	SP 15	32400155
Clamp Ring	Set (2 pieces)	SP H	32400152
Reducing Ring*	15 mm to 12 mm	RR 12	32220291
Reducing Ring *	15 mm to 10 mm	RR 10	32220292
Reducing Ring *	15 mm to 8 mm	RR 8	32220295

Tab. 25 List of Accessories

Appendix B: History and Compatibility

History encoder generations

This chapter gives you information about older types of absolute rotary encoder with CANopen interface. Technical changes and compatibilities between the different types are specified.

Encodergeneration Optocode

Since September 2009 the second CANopen encoder generation, namely OPTOCODE-II, replaces the OPTOCODE encoders.

To guarantee conformity to CiA standard the encoders had to be changed in a way, that they are not fully compatible to the old types anymore.

Overview of the incompatibilities:

- LED-behaviour
- Object 1802h second TPDO
- Object 1000h Device Type is not 196h
- Restore command
- BCD-switch position 9 in the connection cap

3.2 Boot-up-time

The encoder line needs less time to send the Boot-Up message after switching on.

old OCD-series	new OCD-II-series
Ca. 3000ms	Ca. 250 ms

3.3 Object 1802h

In the past the second PDO could be parameterised by the object 1801h and 1802h. This is not consistent with the CiA standards and will be ended with the new encoder line. This means in the future the second PDO can only be parameterised via object 1801h.

New versions

	C6, CA (CiA-Conform)	Mode	COB-ID
1800h	PDO1	Asynchronous	180h
1801h	PDO2	Cyclic	280h
1802h	PDO3	Optional Cyclic (not used in C6)	380h

Old versions

	C2 and C5	Mode	COB-ID
1800h	PDO1	Asynchronous	180h
1801h	PDO2	Cyclic	Not used!
1802h	PDO2	Optional Cyclic (used in C2/C5)	280h

3.4 Objekt 1000h Device Type is not 196h

Object 1000h contains a coded description of CAN devices. Until now 196h was written to all encoder types. According to the standards singleturn and multiturn must be distinguished:

- Singleturn → 10196h
- Mutliturn → 20196h

3.5 Restore Command

In the past the restore command set the encoder to customised default values The restore command sets the encoder to POSITAL default values, which are defined in the user manual. Communication parameters like node number and baud rate are not restored.

3.6 Connection Cap BCD-switch setting "9"

The, former undefined, BCD-switch setting "9" in the connection cap is used to set the encoder in a mode, that ignores the switch setting for baud rate and node number. The parameters can be modified by SDO messages and LSS, only.

3.7 C2-C5-Work-around

With little limitations, the new OCD-II-encoder line will be compatible to the current version. It will be possible to use the old EDS-file for configuration purposes in the PLC with the new encoder and no errors will occur. Merely the enhanced functions, like velocity- and acceleration-output, will not be available.

In case for unexpected problems, there is the possibility to set the CA-encoder in a compatibility mode, that will restore the old C2-C5-behavior.

There are the following procedures to set this mode:

- Manual, with the BCD-switch in the connection cap:
  - Remove cap from encoder
  - Set node number 97
  - Reconnect connection cap → Both LEDs will glow in red.
  - Remove connection cap again and set back to the needed node number
  - Reconnect connection cap → C2-C5-Behavior
- Via Software:
  - Set object 3030h subindex 1h to „ONE" via SDO-commando
  - Hard- or Software RESET

CA00

Type key

Nr.	type key **old**	type key **new**	comment
1	58XX-XXXX-XBA1C203PG	58XX-XXXX-XB**B1**C203PG	encoder CAN
2	AH58-CA-3PG	AH58-**B1**CA-3PG	connection cap CAN

X: wildcard for various designs

Version history connection cap

In particular the design of the connection cap is improved. Easier installation due to a new type of screw terminals inside of the connection cap. On the back of the connection cap two multi-color LEDs are implemented for easy diagnosis. The terminal resistor is hooked up via a slide switch. Thus continuative bus connection will be cut off. The localisation of accidentally switched on terminal resistors will be made easier. The device address and the baudrate will be adjusted via BCD switches. This made the installation easier.

Changes of the CANopen protocol

The following changes have not be relevant to you because only specific function according to the newest CANopen specification (DS-301 V4.0) are not supported anymore or are new implemented. If your application doesn't use this function, there will be no problem.

Changes of entries in object dictionary

Relevant changes apply to the boot-up message, as well as some entries in the CANopen object index not used by the common user. A complete list of these objects you can find in the following table.

object-nr. (hex)	comment	CANopen profile DS301 V3.0 58XX-XXXX-XBA1C203PG	CANopen profile DS301 V4.0 58XX-XXXX-XBB1C203PG
1004	Number of PDOs supported	supported	according to DS301-V4.0 not supported anymore
100B	Node-ID	supported	according to DS301-V4.0 not supported anymore
100E	COB-ID Guarding protocol	supported	according to DS301-V4.0 not supported anymore
1016	Consumer heartbeat time	reserved	supported
1017	Producer heartbeat time	reserved	supported
1018	Identity Object	reserved	supported

Changing transmit PDO communication parameter

In the new encoder generation the polling isn't supported anymore if the PDO is disabled. According to CANopen specification DS301-V4.0 it is necessary to set the cyclic time (object entry [2200h]) to 0 and left the PDO switched on to poll the encoder. Important! If the PDO is switched off no communication is possible.

Polling in Pre-Operational state

The old generation has accepted polling requests in pre-operational state, but wasn't correct according to CANopen standard. In the manual for the old encoder was a hint, that the polling request is not allowed in pre-operational state, because it is not defined in the CANopen standard. So be aware that the new encoder is in general not accepting poll requests in pre-operational state independent of configuration of the behavior as new or old encoder.

Changes in boot-up sequence

If the old encoder generation is connected to the supply voltage or a NMT message (reset node, reset communication) is sent to the encoder, a boot-up message appears. The telegram structure looks like this: identifier: 80hex + node number, data length 0 bytes

This message was not defined by the specification DS301 V3.0, but vendor specific used by some manufactures to show that the device is 'alive'.

According to DS301 V4.0 the new rotary encoder generation doesn't support this message anymore. In place of the old message a common valid boot-up message is defined. The structure looks like this:

identifier: 700hex + node number, data length 1 byte

This boot-up message also appears if the command 'reset node' and 'reset communication' is sent to the encoder.

Handling of spare parts

Boot-up message new encoder and old connection cap

To use the new encoder generation as spare part for the old encoder generation, the new encoder recognize the old connection cap type and support the specification DS301-V3.0 automatically as well as the appropriate boot-up message.

Changing of the default BootUp message of the B1 version

To get the same boot-up behavior of the old encoder generation if you use the new encoder generation and the new connection cap type there will be following solution:

The needed protocol type will be activated via a defined device address. Please use the following configuration sequence:

1. Setting the needed address (s. table below).
2. Connect the connection cap to the encoder.
3. Switch on supply voltage.
4. Wait until both LEDs are red.
5. Switch off supply voltage.
6. Remove connection cap.
7. Set up the correct device address. (0-89)
8. Connect the connection cap to the encoder.
9. Switch on supply voltage.

normal operation.

Profile according C2 encoder	Protocol DS301-V3.0	Protocol DS301-V4.0
address 97	address 98	address 99

Besides the set up via hardware there is also the possibility to set up the protocol via SDO objects. For further information please refer the manual.

Appendix C: Glossary

A

Address	Number, assigned to each node, irrespective of whether it is a master or slave. The encoder address (non-volatile) is configured in the base with rotary switches or SDO objects.
APV	Absolute Position Value.

B

Baud rate	Transmission speed formulated in number of bits per second. Bus node Device that can send and/or receive or amplify data by means of the bus.
Byte	8-bit unit of data = 1 byte.

C

CAL	CAN application layer.
CAN	Controller Area Network or CAN multiplexing network.
CANopen	Application layer of an industrial network based on the CAN bus.
CCW	Counter-clockwise
CiA	CAN In Automation, organization of manufacturers and users of devices that operate on the CAN bus.
COB	Elementary communication object on the CAN network. All data is transferred using a COB.
COB-ID	COB-Identifier. Identifies an object in a network. The ID determines the transmission priority of this object. The COB-ID consists of a function code and a node number.
CW	Clockwise

E

EDS file	Standardized file containing the description of the parameters and the communication methods of the associated device.

F

FAQ	Frequently Asked Questions
FC Function code	Determines the type of message sent via the CAN network.

L

Line terminator	Resistor terminating the main segments of the bus.
LMT	Network management object. This is used to configure the parameters of each layer in the CAN. Master "Active" device within the network, that can send data without having received a request. It controls data exchange and communication management.

N

NMT	Network management object. This is responsible for managing the execution, configuration and errors in a CAN network.
NN	Node number

P

PCV	Process Value
PDO	Communication object, with a high priority for sending process data.
PV	Preset Value: Configuration value

R

RO	Read Only: Parameter that is only accessible in read mode.
ROMAP	Read Only MAPable: Parameter that can be polled by the PDO.
RW	Read/Write: Parameter that can be accessed in read or write mode.

S

SDO	Communication object, with a low priority for messaging (configuration, error handling, diagnostics). Slave Bus node that sends data at the request of the master. The encoders are always slaves.

W

WO	Write Only: Parameter that is only accessible in write mode.

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Appendix F: Document history

Version	Date	Comment
1.0	10.10.03	Initial version
1.1	24.10.03	Correction of the type key. List of figures, List of tables added
2.0	06.11.03	Hint protection low voltage added
2.1	08.01.04	Hint temperature cable exit added

2.2	21.05.04	New inner diameter of the cable glances
2.3	24.09.04	SubIndex of RestoreAllParameter changed
11/07	19.11.07	Complete Review of the manual
03/08	30.03.08	Complete Review, due to OCD-CA00 introduction
07/09	28.07.09	Complete Review, due to OCD-CAA1 introduction